

# FAME Science Highlights

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# Project Context

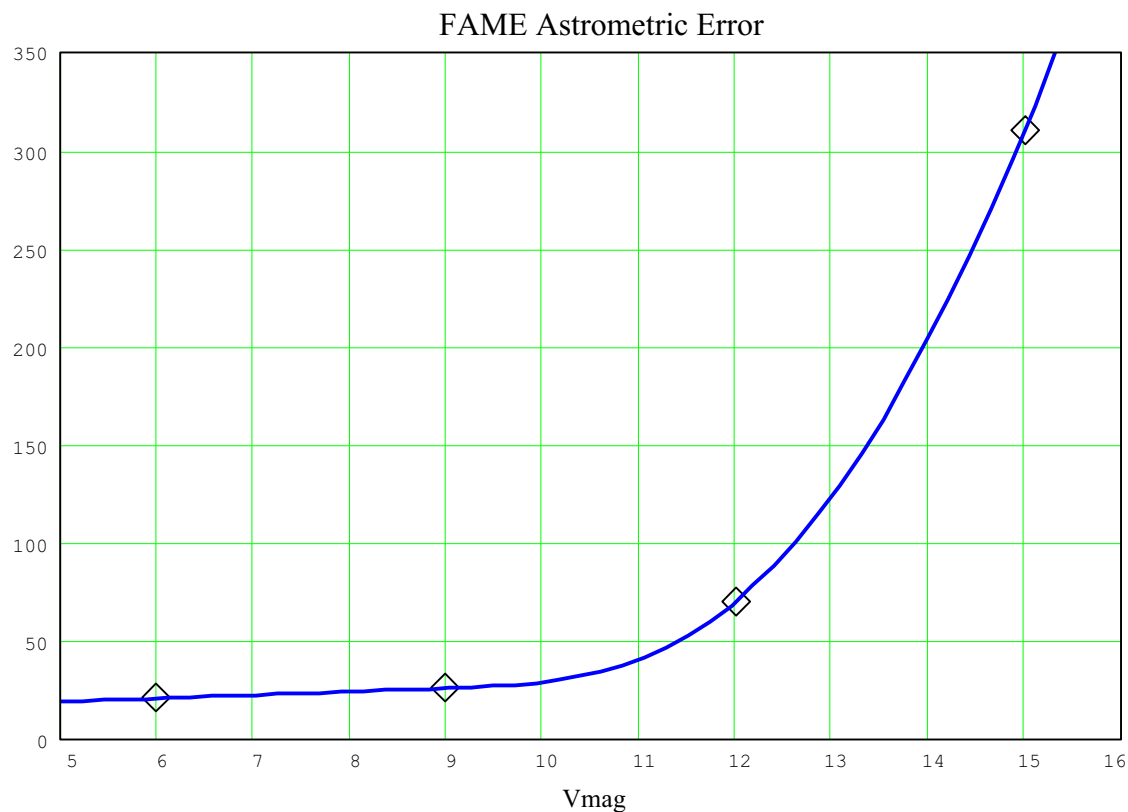
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	errors	Vmag	$\Delta T$ yr	stars	type	global?	cost
cur. ground	~a few mas	?	decades	hundreds	pointed	no	?
Hipparcos	2 mas	~9	2.5	118,000	survey	yes	300 M?
FAME	30-50 $\mu$ as	~12	2.5	a few $10^6$	survey	yes	70 M
Newcomb	10-20 $\mu$ as	14	2.5	a few $10^3$	pointed	yes	80 M
fut. ground	~10 $\mu$ as	~20	10-20	hundreds?	pointed	no	100 M
POINTS	0.3 $\mu$ as	18	5-10	$10^5$	pointed	yes	280 M
OSI	<0.5 $\mu$ as	20?	5-10	$10^4$ ?	pointed	yes	1-2 G

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- astrometric error vs. magnitude:

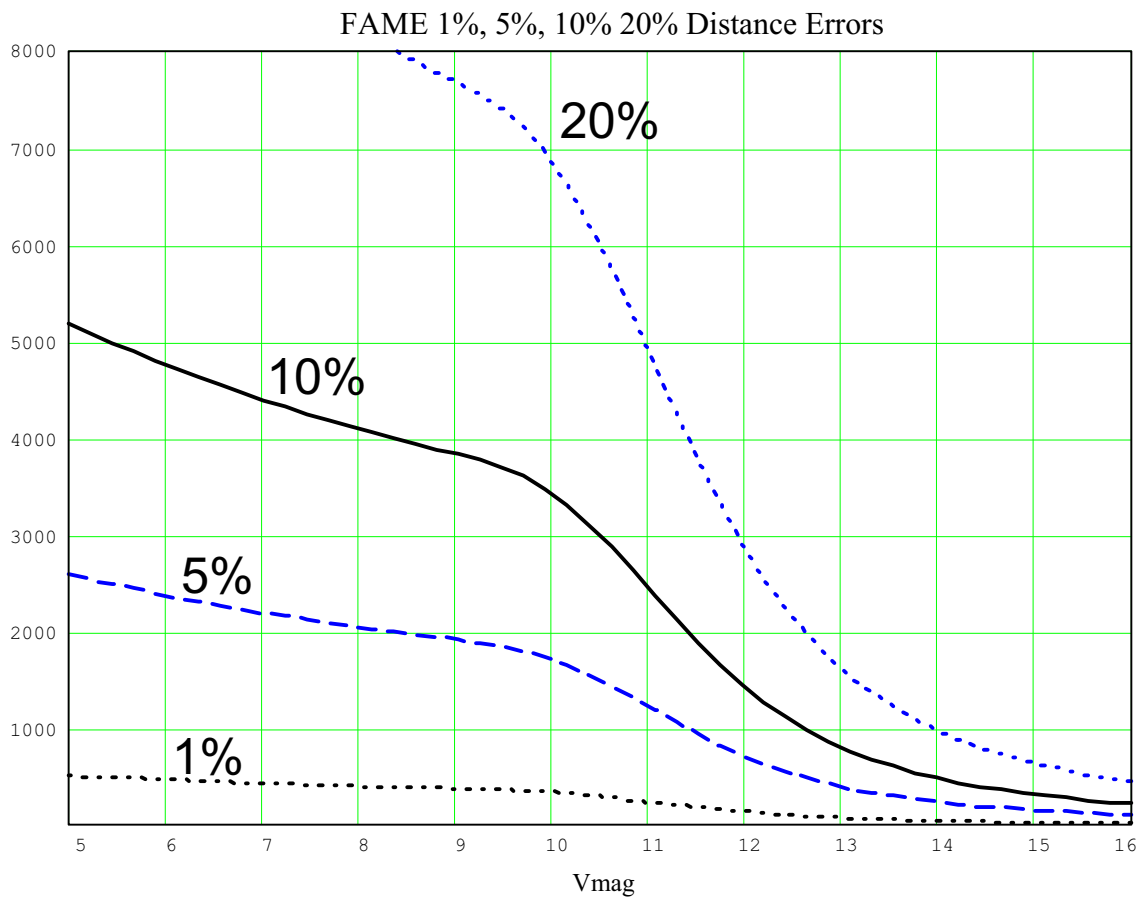


- $30 \mu\text{as} \longrightarrow 10\%$  error at 3.3 kpc

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- Distances (in pc) for 1%, 5%, 10%, 20% distance errors (vs. magnitude):



# *[FAME Volume Plot]*

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- Serendipity
- Extragalactic Distance Scale
  - reddening a problem for all known Cepheids
  - calibrate Cepheid PLC relation (current:  $\sim 10\%$ )
- Galactic Mass Distribution
  - distances & PMs of all spectral types
    - Oort A and B constants
    - distance scale for Galaxy
    - local Galactic rotation curve
    - local escape speed
    - local mass density
    - disk dark matter fraction

# *[FAME Cepheids Plot]*

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## ● Galactic Structure

- Spiral arms: traveling density waves, or propagating star formation?
  - need 5% distance, 1% PM measurements of Perseus Arm ( $\sim 2$  kpc) peculiar motions
- rotation curve beyond Solar circle
- galactic thick disk component
  - need  $< 10\%$  distances to  $> 2$  kpc

## ● Globular Clusters

- FAME: distances and PMs of 5 nearest (1.9 to 3.4 kpc)
- $50 \mu\text{as/yr}$  at 3.3 kpc =  $0.8 \text{ km/sec}$  !

## ● Open Clusters

- old clusters important for Galactic disk evolution
- 19 old clusters with ages  $> 1$  Gyr lie within  $\sim 1.7$  kpc
- need 5% distances
- young clusters: tracers of star formation and spiral arms



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## ● Stellar Masses

- binary systems
- FAME: 2-3 order of magnitude improvement

## ● Stellar Luminosities

- coverage of all spectral types(!)
- refine the mass-luminosity-metallicity-age relation
- finally, definitive absolute magnitude calibrations of early spectral types (O-A)

## ● Evolution of Interacting Binary Systems

- novae & nova-like variables
- Be star x-ray binary systems
- Wolf-Rayet stars
- LMXRBs
- problem: current paucity of definitive mass and orbit determinations

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## ● Exotic Objects

- black hole candidates within reach of FAME:

	$m_v$	d (kpc)	$M/M_{\text{sun}}$	$\sigma_d$ (%)
V616 Mon	11.3-20	1.0	>3-9	5
Nova Mus 1991	13.4-20	1.4	?	20
Cyg X-1	9	2.5	9	7
V404 Cyg	11.5-18	1-3	8-15?	5-15

## ● Global Reference Frame

- FK5:  $\sim 10$  mas at epoch  $\sim 1940$
- optical/radio frame disparity  $\sim 10$  mas
- with PM errors,  $\sim 10$  mas at time of FAME
- FAME:  $\sim 50 \mu\text{as}$ , tied to radio frame

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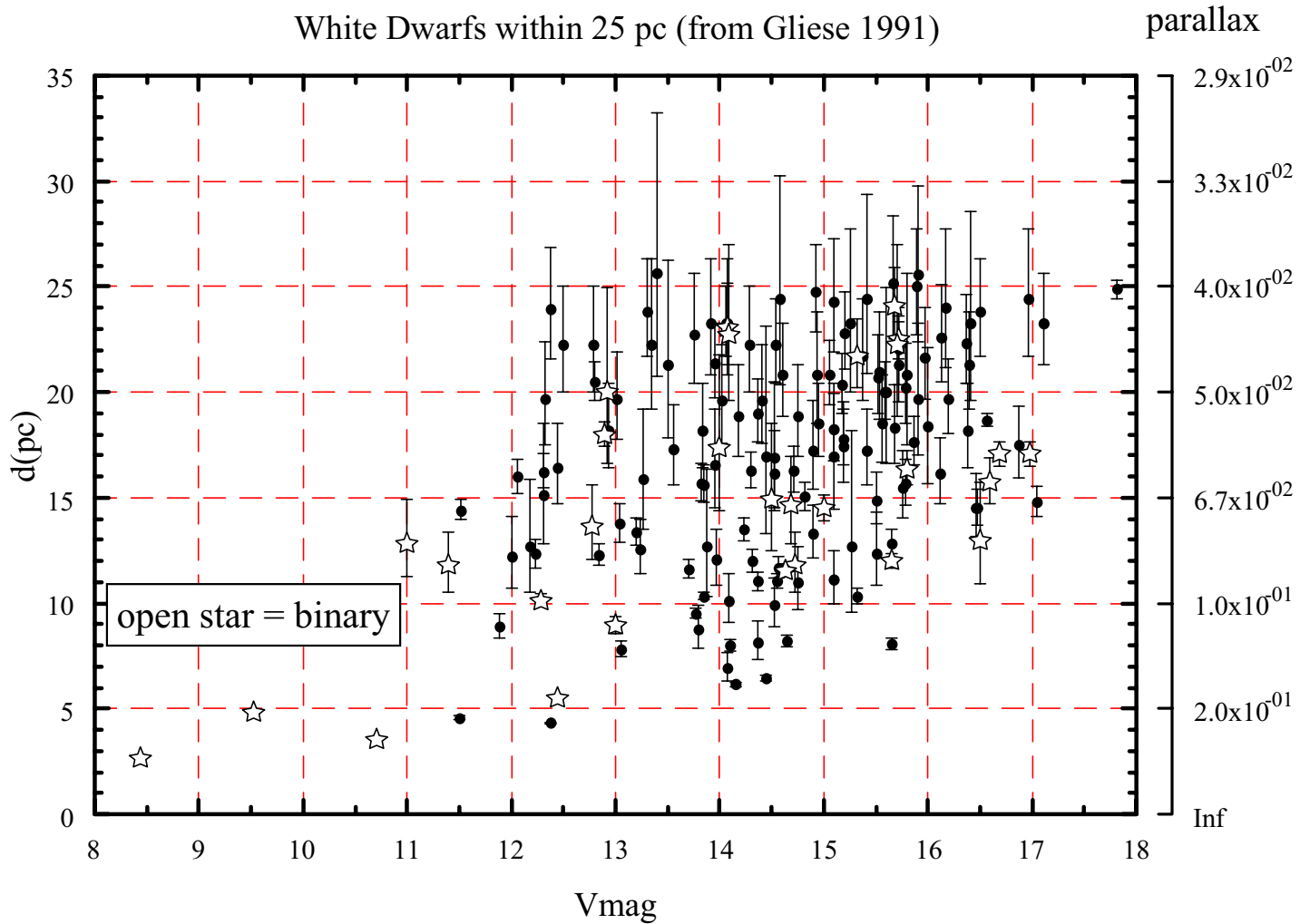
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## ● White Dwarfs

- distances currently very uncertain
- 162 known within 25 pc
- M-R relation poorly calibrated, due mostly to uncertain distances
- mass distribution has implications for
  - progenitor population(s)
  - Galactic evolution
- FAME would nail the WD distance problem.

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## ● White dwarf distances:



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## ● What FAME could do:

